The Golden sun moth, *Synemon plana* Walker (Castniidae): continuing conservation ambiguity in Victoria

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Abstract
Recent discoveries of Golden Sun moth populations resulting from improved sampling techniques have considerably increased the number of populations known on threatened native grassland sites, and accentuated the controversy between pressures for development to cater for urban expansion and for conservation, and the compromises that might be achieved. Implications of this expanding knowledge and directions of recent policy documents are discussed. (*The Victorian Naturalist* **129** (3), 2012, 109–113)

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Introduction

The locally endemic Golden Sun moth (GSM, *Synemon plana* Walker) has become a controversial flagship insect for conservation in south eastern Australia. Its major habitats, remnant patches of lowland native grasslands, have become highly desirable—particularly near cities—for development to accommodate the housing and support needs for rapidly expanding human populations. The projected expansion of Melbourne over the next few decades, for example, encompasses plans for massive urban expansion to the west, north and southeast of the present urban area. The high legal conservation status of GSM as a protected species provides obligations to prospective developers, in assessing environmental impacts of their proposals, to survey for this moth and determine presence/absence and likely size of any populations discovered.

Ambiguities over the real conservation status and needs of *S. plana* continue to be debated. It has notoriety through being one of few invertebrates listed nationally as 'critically endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (from 2002), and is listed also under the regional acts covering its entire known range, namely the *Flora and Fauna Guarantee Act 1988* (Victoria, listed in 2003), the *Threatened Species Conservation Act* 1995 (New South Wales, listed in1996), and the *Nature Conservation Act* 1980 (Australian Capital Territory, listed in 2006). It is one of a small portfolio of notable flagship taxa that characterise native grassland and are considered highly vulnerable to changes.

Since these listings were approved, over a period when very few GSM populations were known, increased awareness of the moth's unusual biology and restricted activity pattern has led to discovery of numerous additional populations as surveys have intensified and become better informed, and the numbers of 'spurious absences' resulting from earlier inefficient survey methods have declined. Developers have expressed frustrations over the moth being discovered on many sites in which it seemed unlikely to occur, and over the delays and prohibitions that currently result. Thus 'We've been frustrated by growling grass frogs, bandicoots, mouthless moths, and the golden sun moth in particular' (Tony Domenico, Chief Executive, Urban Development Institute of Australia, quoted in the *Herald Sun* newspaper, 29 November 2011). Notwithstanding the high level of legislative acknowledgement, GSM populations continue to be reported from many parts of its broad historical range (Brown *et al.* 2012), from consultants working from well-defined prescriptive sampling protocols and from urgency of such surveys stimulated by burgeoning pressures to develop the sites. Resulting problems of whether and how to protect GSM populations as they are discovered has massive financial implications in addition to the idealistic conservation ones. GSM has thus become 'the meat' in a very complex sandwich between developers and conservationists. Many of the

concerns noted by New *et al.* (2007) have increased in complexity and urgency during the last few years.

This note includes comments on some aspects of these continuing tensions and the searches for acceptable compromise.

Biological background

Despite substantial increase in knowledge of the distribution of *S. plana,* and of the number of populations discovered, much of its basic biology remains unclear. The short life span of adults, together with their very variable emergence pattern across sites during the flight season lasting up to several months, renders presence/absence far easier to determine than their abundance. However, it is not yet clear whether the life cycle takes one, two or even three years to complete, so that even an occupied site may not reveal adult moths every year. Despite protocols for surveying larvae (by excavating around grasses and direct search) and pupal cases (protruding from the ground surface at adult emergence), these immature stages have not been described formally, and correct identification needs specialist confirmation. The adult is thus the most reliable stage for detection, with the caveats emphasised by Gibson and New (2007) now embedded, with various modifications, within sampling protocols issued to surveyors.

The major outcome has been a more soundly documented assessment of area of occupancy, resulting in a range increase from about 10 km^2 to >150 km^2 (Gilmore *et al.* 2008; Gilmore and Harvey 2010). However, most occupied sites are small, many of them less than 5 ha in extent. Distribution is highly fragmented and, as female moths fly little, further patch losses may increase isolation through further reducing connectivity. There is little doubt that the greatest threats to GSM are loss and increased isolation of habitat, with diminished patch size likely to increase local vulnerability.

Victorian status assessments

Particularly around Melbourne, but also to the west (Brown *et al.* 2012), survey intensity for GSM has increased to become one of the major aspects of grassland assessment. DSE (2010) instituted mandatory survey requirements for GSM in relation to Precinct Structure Plans and under the Strategic Impact Assessment Agreement between Victoria and the Commonwealth. Surveys must be undertaken as part of the environmental impact assessment of every grassland, and areas of non-native vegetation that constitute potential habitats for GSM, that are anticipated for development. Those requirements include (1) a 'desktop survey' for any previous records; (2) site observations, and (3) targeted surveys for the moth by 'qualified and experienced' personnel, with these 'to be done over an appropriate season, duration and intensity'. A substantial list of boundary conditions for surveys has been defined (DSE 2010: 19), but one merits particular comment here. This is that 'Sites .... must be surveyed until either a population (defined as 5 or more moths) is detected or until four surveys, spaced at least one week apart, have been completed', after which a population is assumed to be absent. The principle of repeated surveys is to compensate for vagaries in moth emergence times, with the proviso that, if moths are discovered, later surveys are abandoned. However, advice for later surveys (if they are needed) includes reducing transect width from 50 m (survey 1) to 25 m (survey 2) to 10 m (surveys 3, 4), so increasing sampling intensity over the same total areas. A further condition relates to vegetation, and emphasises another current gap in understanding. If native vegetation mapping has confirmed that the entire site is non-native vegetation, a maximum of two surveys (rather than four) is needed before deeming GSM absent. The declared alien noxious weed Chilean Needle Grass *Nassella neesiana* Trin & Rupr. is highly likely to be a larval food plant for GSM (Richter *et al.* 2009), and might prove to be an important food resource when native grasses are scarce, supporting populations of GSM on sites regarded as degraded. Indeed, very large GSM populations have been reported on *Nassella*-infested sites near Canberra (Richter *et al.* 2009) and their occurrence on sites with much *Nassella* is common also in Victoria (Gilmore *et al.* 2008). At present, *Nassella*-dominated sites cannot be reliably excluded as harbours for *S. plana*, and might be important habitat patches in the landscape. It is important that this pos-

sible interaction be clarified as a component of finding the conservation balance between a generally undesirable weed and a highly desirable moth.

The needs for repeated surveys have proved contentious, with the wish of developers to reduce survey intensity (and, so, costs and time delays) countered by calls from conservationists to assess presence/absence as reliably as possible, and counter the variations in adult emergence adequately. Reducing transect width can increase chances of detecting small or previously overlooked populations; increasing survey numbers and extent also increases chances of detecting them. DEWHA (2008) noted that 'Surveys should be designed to maximise the chance of detecting Golden Sun moth'.

The low threshold of 5 individuals for a population initially seems sympathetic. However, numbers can vary enormously in the short term, and any such single snapshot may prove very misleading for the presence and actual size of any population present. With population size a determinant of whether an occupied site may be conserved or sacrificed, any such evaluation would be much more convincing if based on cumulative counts from a series of visits. The suggestion of forgoing later surveys once the moth is detected is simplistic in emphasising presence, not population size, and cannot be a valid indicator of the latter. However, the primary survey aim to date has simply been to define whether a GSM population is present on a surveyed site, with considerable logistic constraint on the survey intensity possible. With the development time of GSM unknown, as noted above, even an absence for an entire season might not constitute true absence but simply a low abundance of one seasonal cohort, with a second or even third season needed before absence is truly confirmed. The difficulties of optimal survey protocols for GSM are appreciated widely, and these will undoubtedly be modified further as needs and policy become better defined.

Consequences

Victoria's approach to GSM conservation is given in some detail in a draft 'Sub-regional Species Strategy' (DSE 2011) that, although focused on areas within Melbourne's expected 2010 Urban Growth Boundary, is also couched in more general terms and contains a strong commitment that 'eighty percent of the highest priority habitats for Golden Sun moth within the Victorian Volcanic Plains bioregion will be permanently protected and managed' (DSE 2011: 8). 'Highest priority habitats' are defined as places where 'high contribution to species persistence' and 'confirmed habitat' intersect. The latter refers to the threshold of five moths being recorded, and the former to areas of native vegetation (defined as at least 25% of understorey vegetation cover) within potentially well-connected GSM habitats where 'connected' refers to breaks in habitat of less than 200 m, as an unproven measure reflecting the moth's low dispersal ability. A detailed prescription to meet this target is provided and, if followed, appears to provide soundly for GSM through protection of key habitats. It was signed off by the Commonwealth Minister in April 2010. The principles of habitat offsets and optimal mitigation methods have been discussed extensively in conjunction with these commitments and the site triage they engender.

Criteria for retaining small habitat patches are clearly specified within the five components of the DSE (2011) plan (Table 1), but numbers 3 and 4 are particularly innovative. Together, they provide for permanent protection of grassland reserves, to be acquired over 10 years outside the Urban Growth Boundary, and management of selected smaller reserve areas to 'provide insurance against risk of catastrophic events in the larger areas', drawing on experiences that very small reserves can indeed sustain GSM populations. (Table 1)

Habitat offsets

The strategy of compensating for habitats sacrificed or lost to human pressures by substituting other areas has been advanced in many different conservation contexts, as a politically-appealing mitigation course of action. Broadly 'Environmental offsets' are defined as 'Actions taken outside a development site that compensate for the impacts of that development'. The several possible options include providing replacement habitats (either discrete or abutting sacrificed patches) and enhancing remaining habitat to increase carrying capac-

ity, but the common aim is for no net loss and no increased vulnerability to result to the focal species. In the past, the practice has sometimes been rather casual, but formalisation of the approach with adequate monitoring of procedure and outcomes can appeal to developers as providing a cost-effective means of compliance with environmental demands that can expedite approval of applications for development, and be undertaken through clearly defined requirements. Developers may also garner favourable publicity through demonstrating corporate social responsibility. However, habitat offsets are not a 'quick fix', as commonly presumed, simply because habitat quality, including supply of critical resources for focal species, must be assessed for equivalence to the sacrificial site, and replacement sites should be in place—and their future security and continuing management assured—before loss of the original site. There have also been concerns over 'progressive losses' of sites by removal of small proportions at intervals over, perhaps, many decades. The EPBC Act Policy Statement 3.12 (DEWHA 2008) sets out parameters for mitigation of habitat loss, whilst DSE (2010) recognises three classes of offsets depending on their contribution to a species' persistence as high, medium or low. Thresholds devised by DEWHA (2008) are 'not designed to be prescriptive' and apply on a case-by-case basis.

Offsets are required for removal of any habitat within a land parcel where GSM has been confirmed to occur, with different levels of need (as DSE 2010, above) leading to offset credits of fixed rates made available to developers.

The future

The biological and regulatory complexities of GSM conservation have been important in honing the wider issues of (1) the significance of remnant grasslands and grassy woodland areas throughout its range, and (2) how such species may be surveyed and conserved effectively. Debate over optimal sampling and population estimation will assuredly continue, together with urge for well-founded triage to conserve the most significant populations of this genetically diverse species and enable development to proceed on rationally selected sites and without compromising the survival of *S. plana*.

Translocations have been proposed, as a means to salvage *S. plana* from sacrificial sites, by techniques such as (1) translocating female moths, presumed to mate early in life and (2) direct transfer and insertion of sods of native grasses with subterranean caterpillars. Neither has proceeded beyond initial trials to established practice and the increased number of populations now known has perhaps reduced the need to advance these themes. However, any such attempts should be documented fully and monitored effectively.

Despite the complexity of obligations from listing under four different Acts intended to promote its conservation, practical efforts to achieve this have been rather fragmented. The leads provided through the Victorian perspective should be considered within a national context and a comprehensive and, as far as possible, agreed national recovery plan be produced to guide continuing efforts. There is need, also, for an available agency-centred directory of sites, explorations and surveys with full information on their status and outcomes, and within which all further results can be incorporated, appraised, and made available widely.

Finally, the conservation status of GSM may need to be reappraised critically. The extent of recent discoveries suggests that it may not now meet the strict criteria for national 'critically endangered' status (Gilmore and Harvey 2010),

Table 1. The five main components of the 'Sub-regional strategy' proposed for conservation of *Synemon plana* in Melbourne's urban growth zones (DSE 2011)

1. Long-term target of 80% of the highest priority habitat for *Synemon plana* within the Victorian Volcanic Plains bioregion to be protected.
2. Prescription to guide day-to-day management, with clearing of habitat conditional on offsets designed to specified criteria.
3. Large areas of habitat permanently protected, including western grassland reserves, and to be acquired over 10 years.
4. Smaller reserves to manage risks and retain genetic diversity of *Synemon plana*.
5. Greatly improved information, through strategically placed surveys and habitat information to facilitate informed management decisions.

but any revision must also consider the species' vulnerability, and how that might be increased if its restricted habitat was rendered more susceptible to loss if the conservation status of this notable flagship species was downgraded. Dedicated sun moth reserves (such as the pioneering one at Nhill, Victoria, discussed by Douglas, 2004) have considerable importance, but susceptibility of native grasslands to weed invasions, succession and externally imposed changes necessitates continued management of any such areas. The important commitment noted above, of assuring security of selected Victorian grasslands for perpetuity, can be realised only from continuing support from the relevant agencies and interested community groups. The need for increased ecological information to inform management and priority is clear. Whilst the moth can now be detected by simply replicable techniques (even if extended over more than one flight season to counter vagaries of demography), biological features (such as the possible important role of *Nassella* in its larval ecology) need further clarification, in having clear implication for future conservation practice.

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Dark purple azure.
Photo by Michael F Braby.